Refer to:
2004/00523 (NOAA Fisheries tracking #)
04-2651 (USFWS tracking #)
8330.03523(04) (USFWS file #)

July 1, 2004

Nancy H. Weintraub
Environmental Specialist
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fisheries and Conservation Management Act Essential Fish Habitat Consultation for the Catherine Creek/Swackhammer Fish Passage and Erosion Project, Upper Grande Ronde Subbasin, Catherine Creek Watershed, Union County, Oregon (USFWS Sec 7 # 1-17-04-F-0352).

Dear Ms. Weintraub:

Enclosed is a joint biological opinion (Opinion) prepared by NOAA's National Marine Fisheries Service (NOAA Fisheries) and the Fish and Wildlife Service (USFWS) pursuant to section 7 of the Endangered Species Act (ESA) on the effects of funding the proposed Catherine Creek/Swackhammer Fish Passage and Erosion Project. In this Opinion, NOAA Fisheries concludes that the proposed action is not likely to jeopardize the continued existence of Snake River (SR) spring/summer Chinook salmon (*Oncorhynchus tshawytscha*), SR steelhead (*O. mykiss*), nor destroy or adversely modify designated critical habitat for SR spring/summer Chinook salmon. The USFWS concludes that the proposed project is not likely to jeopardize the continued existence of bull trout (*Salvelinus confluentus)*. As required by section 7 of the ESA, NOAA Fisheries and the USFWS included reasonable and prudent measures with nondiscretionary terms and conditions that they believe are necessary to minimize the impact of incidental take associated with this action.

The enclosure also documents consultation on essential fish habitat (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and its implementing regulations (50 CFR Part 600). NOAA Fisheries concludes that the proposed action may adversely affect designated EFH for Chinook salmon and coho salmon (*O. kisutch*).

As required by section 305(b)(4)(A) of the MSA, included are conservation recommendations that NOAA Fisheries believes will avoid, minimize, mitigate, or otherwise offset adverse effects on EFH resulting from the proposed action. Section 305(b)(4)(B) of the MSA requires that a Federal action agency must provide a detailed response in writing within 30 days of receiving an EFH conservation recommendation.

If you have any questions regarding the consultation on SR spring/summer Chinook salmon or SR steelhead, please contact Eric Murray in NOAA Fisheries' Eastern Oregon Branch at (541) 975-1835, ext. 222. For questions regarding bull trout, please contact John Kinney in the Fish and Wildlife Service La Grande Field Office at (541) 962-8584.

Sincerely,

for Michael R Crouse

Gary S. Miller

D. Robert Lohn
Regional Administrator
Northwest Region
NOAA Fisheries

Gary S. Miller
Field Supervisor
La Grande Field Office
U.S. Fish and Wildlife Service

cc: John Kinney, USFWS
Jeff Zakel, ODFW
Larry Salata, USFWS, Region 1, Portland, OR (electronic)

Endangered Species Act Section 7 Consultation
Biological Opinion

and

Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation

Catherine Creek/Swackhammer Fish Passage and Erosion Project
Upper Grande Ronde Subbasin, Catherine Creek Watershed,
Union County, Oregon

Lead Action Agency:	Bonneville Power Administration
Consultation Conducted By:	NOAA's National Marine Fisheries Service, Northwest Region
	U.S. Fish and Wildlife Service La Grande Field Office
Date Issued:	July 1, 2004
Issued by:	D. Robert Lohn NOAA Fisheries Regional Administrator
	Gary S. Miller US Fish and Wildlife Service Field Supervisor
NOAA Fisheries Tracking No.:	**2004/00523**
USFWS Tracking No.:	**04-2651**

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1. INTRODUCTION

The Endangered Species Act (ESA) of 1973 (16 USC 1531-1544), as amended, establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with NOAA's National Marine Fisheries Service (NOAA Fisheries) and U.S. Fish and Wildlife Service (together "Services"), as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitats. This biological opinion (Opinion) is the product of an interagency consultation pursuant to section 7(a)(2) of the ESA and implementing regulations 50 CFR 402.

The analysis also fulfills the essential fish habitat (EFH) requirements under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (section 305(b)(2)).

The Bonneville Power Administration (BPA) proposes to fund the Catherine Creek Swackhammer Fish Passage and Erosion Project (Project). The Grande Ronde Model Watershed Program, Swackhammer Ditch Company, and downstream landowners are the Project cooperators. The Bureau of Reclamation (BOR) provided the engineering design for the Project.

1.1 Background and Consultation History

The Swackhammer Diversion Structure (SDS) is a channel-spanning irrigation diversion weir on Catherine Creek about 100 meters east of the town of Union, Oregon. The SDS underwent reconstruction in 1995 to improve fish passage. A single step structure with an inadequate fish ladder was replaced by a two-bay concrete weir. Due to a mistake during facility design, the SDS was installed at an elevation that does not allow for the intended operation of the structure.

The operation of the SDS requires placing flashboards at the top of the structure. Although the diversion rate has never been measured, it is estimated to be approximately 70% of the current Oregon state water right. The size of the ditch associated with the SDS limits the amount of water that can be withdrawn. When the flashboards are in place, there is a vertical drop of approximately 18 inches between the top of the boards and the uppermost weir structure. This does not meet NOAA Fisheries' draft fish passage criteria for juvenile salmonids (NOAA Fisheries 2004).

The 1995 reconstruction of the SDS disrupted bed load transport in this reach of the stream and caused deposition of streambed material directly downstream from the structure, in the middle of the Catherine Creek channel. As a result, a mid-channel gravel bar is forming that splits the stream into two channels. Water traveling down the north channel is causing bank erosion and channel migration of up to 20 feet. Continued deposition of channel material may cause an out-of-bank flow, resulting in flooding of residential areas.

The Services received a letter requesting formal ESA section 7 consultation and EFH consultation on the Project on May 3, 2004. A complete biological assessment (BA) was also received at this time and formal consultation was initiated.

On June 10, 2004, the Services met with representatives from the Grande Ronde Model Watershed Program and BOR. During this meeting, the Services discussed ways to modify the proposed Project design to minimize effects to ESA-listed species. The Grande Ronde Model Watershed Program and BOR agreed to make the suggested changes.[1]

The objective of this Opinion is to determine whether the Project is likely to jeopardize the continued existence of SR spring/summer Chinook salmon, SR steelhead, and bull trout or modify designated critical habitat for SR spring/summer Chinook salmon. The objective of the EFH consultation is to determine whether the Project may adversely affect designated EFH for the relevant species, and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects on EFH resulting from the action.

1.2 Proposed Action

Proposed actions are defined in the Services' consultation regulations (50 CFR 402.02) as "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas." Additionally, the MSA at 16 USC 1855(b)(2) further defines a Federal action as "any action authorized, funded, or undertaken or proposed to be authorized, funded, or undertaken by a Federal agency." Because the BPA proposes to permit the Project, which may affect listed resources, it must consult under ESA section 7(a)(2) and MSA section 305(b)(2).

The BPA proposes to fund the Project on Catherine Creek in the Upper Grande Ronde subbasin. The legal description of the project area is Union County, T4S, R40E, Sec.19. This area is within designated critical habitat for SR spring/summer Chinook salmon.

The purpose of the proposed Project is to: (1) Improve fish passage at the SDS; (2) make structural changes to the SDS and associated irrigation ditch to eliminate the need for flashboards; (3) alter the SDS so it will better transport bed load material; and (4) prevent further bank erosion downstream by constructing several rock vane structures at the site.

The SDS will be modified by installing 2 additional concrete weir walls within the existing structure. This will reduce the drop at each weir to approximately 8 inches. The existing weir

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[1] Electronic mail (July 14, 2004) from Lyle Kuchenbecker regarding Project design.

will be modified by filling the existing 17-inch wide flow notches and cutting 6-inch wide flow notches for fish passage. The modifications to the concrete structure will take 2 to 4 weeks to complete and will take place during the Oregon Department of Fish and Wildlife (ODFW) in-water work window for the area, July 1st to July 31st. Flows in Catherine Creek are expected to be between 10 and 20 cubic feet per second (cfs) at the time of construction. A cofferdam will be installed to isolate the work area and a bypass channel will be constructed next to the south bank of Catherine Creek. Some of the water impounded by the cofferdam will be piped to the SDS ditch to provide irrigation water during construction. The dewatering plan is detailed in Figure 1 of Appendix A of this document. New flow notches will be cut in the existing weirs, and rebar anchors will be installed for the new weirs walls. Then the new concrete weirs will be poured into forms. The BA states that the forms are usually left in place for 7 days, after which flow will be restored and the concrete will continue to cure with water running through the site.

The irrigation ditch and headgate associated with the SDS will be lowered by 1 foot, eliminating the need for placing flashboards on the SDS during irrigation season. The fish screen at the ditch will also be lowered 1 foot.

A small portion of the gravel bar forming below the SDS will be removed by relocating streambed material to the north side of Catherine Creek, at the site of bank erosion. Willows growing on the gravel bar will be transplanted in the reconstructed bank. The existing conditions at the site and proposed excavation of the gravel bar are detailed in Figure 2 in Appendix A.

Two J-hook rock structures and one cross vane rock structure were proposed to direct stream flow through the middle of the SDS and then through the middle of the channel below the structure. After discussions with the Project proponents, the J-hook downstream of the SDS was eliminated from the Project design. Under the current Project proposal, one J-hook will be installed approximately 70 feet upstream from the SDS. A cross vane structure will be installed approximately 120 feet downstream from the SDS. The rock structures are detailed in Figure 3 of Appendix A. An additional cofferdam will be installed to construct the rock cross vane and pumps may be used to further dewater the work area.

The following conservation measures have been proposed for the Project:

- A pollution control plan will be developed.
- No refueling of machinery will take place within 150 feet of the stream.
- All equipment that is to be used for instream work will be cleaned before entering the construction area.
- Appropriate erosion control practices such as silt fences and straw bales will be used.
- Any unused construction materials will be disposed of at least 300 feet from Catherine Creek.
- All disturbed soil will be revegetated.

2. ENDANGERED SPECIES ACT

2.1 Biological Opinion

2.1.1 Biological Information

SR Steelhead

The SR steelhead evolutionarily significant unit (ESU) was listed as threatened on August 18, 1997 (62 FR43937). Protective regulations for SR steelhead were issued under section 4(d) of the ESA on July 10, 2000 (65 FR 42422). Biological information for SR steelhead is found in Busby *et al.* (1996). Recent counts of upstream migration at Lower Granite Dam show at least some short-term improvement in the numbers of adults returning to spawn. The Grande Ronde River is one of the principal basins in the Snake River drainage contributing to salmon and steelhead production. Interim abundance targets for SR steelhead are found in Table 1.

Table 1. Interim abundance targets for Snake River steelhead in the Grande Ronde River spawning aggregation (Adapted from NOAA 2003)

<table>
<tr><th>ESU/Spawning Aggregations*</th><th>Interim Abundance Targets</th><th>Interim Productivity Objectives</th></tr>
<tr><td colspan="2">Snake River Steelhead ESU</td><td rowspan="7">Snake River ESU steelhead populations are well below recovery levels. The geometric mean Natural Replacement Rate (NRR) will therefore need to be greater than 1.0.</td></tr>
<tr><td>Grande Ronde</td><td></td></tr>
<tr><td>Lower Grande Ronde</td><td>2600</td></tr>
<tr><td>Joseph Creek</td><td>1400</td></tr>
<tr><td>Middle Fork</td><td>2000</td></tr>
<tr><td>Upper Mainstem</td><td>4000</td></tr>
<tr><td>Imnaha</td><td>2700</td></tr>
</table>

*Population in bold is addressed in this Opinion

The SR steelhead ESU occupies portions of southeastern Washington, northeastern Oregon, and north/central Idaho. Environmental conditions within this ESU are generally drier and warmer than in other steelhead ESUs. The SR steelhead run is considered a summer run based on adult upstream migration. Adults enter the Columbia River in the summer, migrating upriver until they spawn in the spring between March and May. Runs found in the Grande Ronde system are generally A-run fish, or fish that have spent one year in the ocean.

There are very few annual estimates of steelhead returns throughout the Snake River basin. Returns over the Lower Granite Dam were low during the 1990s, however, run estimates in the Grande Ronde and Imnaha Rivers have improved since the 1990s (NOAA 2003). The long-term population trends have remained negative, while the short-term population trend for the ESU has improved in comparison to the time frame analyzed in the last status review (NOAA 2003). The median long-term population growth rate (λ) is 0.998 based on the assumption that only natural-origin spawners return from wild stock (NOAA 2003). The short-term λ, based on the same assumption, is 1.013 (NOAA 2003). Assuming that both hatchery and wild fish contribute to the natural production in proportion to their numbers, the long-term λ is 0.733 and short-term λ is 0.753 (NOAA 2003). In spite of the recent increases in numbers, the majority of populations in the ESU with abundance data are still well below the interim abundance targets (Table 1).

Important features of the adult spawning, juvenile rearing, and adult and migratory habitat for this species are: Substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food (juvenile only), riparian vegetation, space, and safe passage conditions (Bjornn and Reiser, 1991; NOAA Fisheries, 1996b; Spence *et al.*, 1996)

SR Spring/Summer Chinook Salmon

SR spring/summer Chinook salmon ESU was listed as threatened on April 22, 1992 (57 FR 14653) and critical habitat designated on October 25, 1999 (64 FR 57399). SR Spring/Summer Chinook salmon enter the Columbia River in late February and early March. Fish hold in the cooler deep pools until the late summer and early fall when they return to their native streams and begin spawning. The eggs incubate through the fall and winter and emergence begins in the early winter and late spring. Juvenile SR spring/summer Chinook salmon exhibit a stream-type life history. The fish rear for one year in fresh water before they migrate out to the ocean in the spring of their second year. They generally return from the ocean after 2 or 3 years. Interim abundance targets for SR spring/summer Chinook salmon are provided in Table 2.

Table 2. Interim abundance and productivity targets for SR spring/summer Chinook salmon in Oregon (adapted from NOAA 2003).

<table>
<tr><th>ESU/Spawning Aggregations*</th><th>Interim Abundance Target</th><th>Interim Productivity Target</th></tr>
<tr><td colspan="2">Snake River Spring/Summer Chinook salmon</td><td rowspan="3">“For delisting to be considered, the eight year (approximately two generation) geometric mean cohort replacement rate of a listed species must exceed 1.0 during the eight years before delisting. For spring/summer Chinook salmon, this goal must be met for 80% of the index areas available for natural cohort replacement rate estimation.” (Proposed Snake River Recovery Plan; NMFS 1995)</td></tr>
<tr><td>Grande Ronde River</td><td>2000</td></tr>
<tr><td>Imnaha</td><td>2500</td></tr>
</table>

*Population in bold is addressed in this Opinion

Several factors have influenced the decline of SR spring/summer Chinook salmon. Habitat loss from hydroelectric development, habitat degradation from land use activities, and impacts from hatcheries are all responsible for the decline of the stocks. Recent abundance for the ESU has increased. The geometric mean return of naturally-reproducing spawners from 1997 to 2001 was 3,700, which is well below the interim abundance targets for the ESU. The 2001 run was estimated to be 17,000 naturally-reproducing spawners (NOAA 2003). The short-term and long-term productivity estimates (λ) are still well below the interim productivity target for the ESU (Table 2). The Grande Ronde and Imnaha Rivers had the greatest increase in λ for the short-term. Within the Grande Ronde River subbasin, riparian and instream habitat degradation have severely affected SR spring/summer Chinook salmon production potential.

Bull Trout

On June 10, 1998, the USFWS issued a final rule listing the Columbia River and Klamath River populations of bull trout as threatened (63 FR 31647) under the authority of the ESA. This decision conferred full protection of the ESA on bull trout occurring in four northwestern States. The Jarbidge River population was listed as threatened on April 8, 1999 (64 FR 17110). The Coastal-Puget Sound and St. Mary-Belly River populations were listed as threatened on November 1, 1999 (64 FR 58910), which resulted in all bull trout in the coterminous United States being listed as threatened. The five populations discussed above are listed as distinct population segments (DPS), *i.e.*, they meet the joint policy of the USFWS and NOAA Fisheries regarding the recognition of distinct vertebrate populations (61 FR 4722). The USFWS proposed to designate critical habitat for the bull trout on November 29, 2002 (67 FR 71235).

The bull trout is a char native to the Pacific Northwest and western Canada, first described as *Salmo spectabilis* by Girard in1856 from a specimen collected on the lower Columbia River, and subsequently described as *Salmo confluentus* and *Salvelinus malma* (Cavender 1978). The bull trout is a long, slender fish with a large head and jaws relative to its body size. Its tail fin is only slightly forked, and even less so in young fish. Bull trout coloration can be variable, but generally, the body's background color is gray infused with green. Bull trout found in lakes may be silvery grey. The body is covered with small white and/or pale yellowish spots with intermingling pink or red spots that not be always be present. The ventral region can range from white to orange. Bull trout typically have 15 to 19 gill rakers, 63 to 66 vertebrae, and 22 to 35 pyloric caeca. Bull trout of large size can be differentiated from Dolly Varden, with bull trout having a larger head and jaws in addition to the head being more flat. Bull trout have spotless fins with the lower fins having white anterior borders. The spotless fin characteristic of bull trout is often used by fisheries agencies to help promote angler identification of bull trout versus other fish, such as brook trout (*S. fontinalis*) (Behnke 2002).

The historical range of the bull trout includes major river basins in the Pacific Northwest at about 41 to 60^{O} North latitude, from the southern limits in the McCloud River in northern California and the Jarbidge River in Nevada to the headwaters of the Yukon River in the Northwest Territories, Canada (Cavender 1978, Bond 1992). To the west, the bull trout's range includes Puget Sound, various coastal rivers of British Columbia, Canada, and southeast Alaska (Bond 1992). Bull trout occur in portions of the Columbia River and tributaries within the basin, including its headwaters in Montana and Canada. Bull trout also occur in the Klamath River basin of south-central Oregon. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta and Montana, and in the MacKenzie River system in Alberta and British Columbia, Canada, (Cavender 1978, Brewin *et al.* 1997). A comprehensive review of the status of the bull trout is available in Appendix A.

Bull trout in the Grande Ronde River basin are considered to represent one of the 141 subpopulations occurring in the Columbia River DPS. Bull trout are widely distributed in the Grande Ronde River, and both resident and migratory forms occur there (Buchanan *et al.* 1997). Because the Grande Ronde has a high degree of connectivity, and the distribution of migratory fish is wide-spread throughout the basin (Buchanan *et al.* 1997), bull trout associated with this tributary appear to be interacting as one reproductively isolated group. As a result, the Service considers bull trout in the Grande Ronde River to be comprised of one subpopulation, and it is not considered to be at high risk to stochastic events. Spawning and rearing occurs in the Upper Grande Ronde, Minam, Wallowa, and Wenaha River drainages, in addition to Catherine and Lookinglass Creeks (Buchanan *et al.* 1997).

Historic abundance data are lacking for bull trout in the Grande Ronde River, but some limited redd count data are available. In 1996, 29, 39, and 60 redds were observed in Lookinglass, Little Minam, and the Wenaha Rivers, respectively (Buchanan *et al.* 1997 citing Bellerud 1996 and Smith and Knox 1996). These data are indicative of index areas rather than total population size, and should not be construed as escapement levels. No abundance trends are available for the Grande Ronde subpopulation.

In 1968, 18 redds and 36 adult fish were observed in North Fork Catherine Creek meadows (Buchanan *et al.* 1997, citing Zakel ODFW pers. comm. 1996). Forty-three bull trout ranging in size from 121 to 255 millimeters (mm) were captured in a downstream migrant trap on Catherine Creek near the town of Union from 1994 through 1996 (Buchanan *et al.* 1997). Spawning ground surveys from 1998 through 2000 were conducted in the Catherine Creek subbasin. Redd counts reported as redds per mile were 25.4, 8.5, and 21.5 in the North Fork Catherine Creek (ODFW unpublished data 2000). Additional areas surveyed in 1999 where bull trout redds were detected include the South Fork Catherine Creek (1.2 redds per mile), Sand Pass Creek (2.0 redds per mile), and the Middle Fork Catherine Creek (1.0 redd per mile) (ODFW unpublished data 2000).

Ratliff and Howell (1992) segmented the Grande Ronde subpopulation into 12 separate groups of bull trout. Buchanan *et al.* (1997) identified a new group in Deer Creek during their updated status report, which indicated a total of 13 separate groups in the Grande Ronde River. Of these, 8 were considered to be at a moderate risk of extinction, 2 of special concern, and 3 at a low risk. Between the 1992 and 1997 status reports, there were three groups of fish where status was downgraded from of special concern to a moderate risk of extinction (Buchanan *et al.* 1997; Ratliff and Howell 1992). Those groups classified as a low risk are associated with roadless and/or wilderness areas in the Wallowa and Wenaha river drainages.

The extent of bull trout habitat modification is variable within the Grande Ronde River. Large portions of the Wallowa and Wenaha River drainages are comprised of designated wilderness, and as a result have relatively intact habitat. The upper Grande Ronde, Catherine and Lookingglass Creeks, however, contain large amounts of public and private lands where the alteration of habitat can and will probably continue to occur (Buchanan *et al.* 1997). Basin-wide, 29,826 hectares are irrigated by instream diversions (Buchanan *et al.* 1997 citing U.S. Bureau of Reclamation 1981). Buchanan *et al.* (1997) suggested that decreased riparian shade and channel stability, along with increased water temperatures and sedimentation has occurred in the basin as a result of livestock grazing, cropland production and water withdrawals on private and public lands.

Brook trout, introduced into some lakes and streams of the Grande Ronde basin during the 1920s (Buchanan *et al.* 1997 citing Smith and Knox 1996), may be competing and/or hybridizing with bull trout in Hurricane and Bear Creeks. Brook trout are also present in the Minam River, but their numbers are very low and do not appear to be limiting bull trout production (Buchanan *et al.* 1997).

2.1.2 Evaluating the Proposed Action

The standards for determining jeopardy are set forth in section 7(a)(2) of the ESA as defined by 50 CFR Part 402 (the consultation regulations). In conducting analyses of habitat-altering actions under section 7 of the ESA, the Services use the following steps: (1) Consider the status and biological requirements of the species; (2) evaluate the relevance of the environmental baseline in the action area to the species' current status; (3) determine the effects of the proposed action on the species; (4) consider cumulative effects; and (5) determine whether the proposed action, in light of the above factors, is likely to appreciably reduce the likelihood of the species' survival in the wild or adversely modify its critical habitat. In completing this step of the analysis, the Services determine whether the action under consultation, together with all cumulative effects when added to the environmental baseline, is likely to jeopardize the continued existence of the ESA-listed species or result in destruction, adversely modify their critical habitat, or both.

2.1.3 Biological Requirements

The first step the Services use when applying ESA section 7(a)(2) to the listed species considered in this Opinion is to define the species' biological requirements within the action area. Biological requirements are population characteristics necessary for the listed ESU or DPS to survive and recover to naturally-reproducing population sizes, at which time protection under the ESA would become unnecessary. The listed species' biological requirements may be described as characteristics of habitat, population or both (McElhany *et al.* 2000). The habitat features of the listed species that the proposed action may affect are: Substrate, water quality, water temperature, water velocity, cover/shelter, food, riparian vegetation and safe passage conditions.

2.1.4 Environmental Baseline

The environmental baseline is the impact of all past and ongoing human-caused and natural factors leading to the current status of the species and condition of its habitat within the action area. The "action area" is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR 402.02). The action area for this consultation is from the Project area on Catherine Creek downstream to the furthest extent of the turbidity plume created by the Project, approximately 1 mile.

Environmental baseline conditions within the action area were evaluated for the subject actions at the watershed scale. The results of this evaluation, based on the "matrix of pathways and indicators" (MPI) described in *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (NOAA Fisheries 1996), follow. This method assesses the current condition of instream, riparian, and watershed factors that collectively provide properly functioning aquatic habitat essential for the survival and recovery of the species. The BA rated all indicators in the MPI, but divided the chemical contaminant/nutrient indicator into two indicators: chemicals and nutrients.

The BA rated 6 of 19 habitat indicators as "not properly functioning." These include: Temperature, chemicals, pool frequency, width/depth ratios, streambank condition, and peak/base flows. Thirteen of 19 indicators were rated as "functioning at risk." These include: Sediment, nutrients, physical barriers, substrate, large woody debris, pool quality, off channel habitat, refugia, floodplain connectivity, drainage network increase, road density and location, disturbance history, and riparian reserves. No habitat indicators were rated as "properly functioning."

The Upper Grande Ronde subbasin and the Project area within the Catherine Creek watershed are highly disturbed riverine systems degraded by past and present timber harvest, livestock grazing, flood control, urbanization, and withdrawal of water for irrigation (Wissmar *et al.* 1994, McIntosh *et al.* 1994, US Forest Service 2004). Catherine Creek, within the action area upstream and downstream, has been channelized for flood control, cutting off meanders, decreasing habitat complexity, and increasing channel gradient.

2.1.5 Effects of the Proposed Action

Effects of the action are defined as: "The direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR 402.02). Direct effects occur at the Project site and may extend upstream or downstream. Indirect effects are defined in 50 CFR 402.02 as "those that are caused by the proposed action and are later in time, but still are reasonably certain to occur." They include the effects on listed species or habitat of future activities that are induced by the proposed action and that occur after the action is completed. "Interrelated actions are those that are part of a larger action and depend on the larger action for their justification" (50 CFR 402.02). "Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR 402.02).

Activities Involving In-water Work
The BPA has determined that the proposed Project is "likely to adversely affect" (LAA) SR steelhead, SR spring/summer Chinook salmon, and bull trout. Activities involving in-water and near-water construction will cause short-term adverse habitat effects and potentially result in harassment or harm of these listed species.

The construction activities proposed as part of this project will require instream operation of heavy machinery and exposure of bare soil. Potential direct effects include mortality and injury resulting from deposition of fine sediment in downstream reaches, behavioral changes resulting from elevated turbidity (Sigler *et al.* 1984, Berg and Northcote 1985, Whitman *et al.* 1982, Gregory and Levings 1998), and injury resulting from contaminants introduced into the stream.

Increased sedimentation may lead to increased embeddedness of spawning substrates downstream from the Project and reduced incubation success (Bell 1991). Fine, redeposited sediments also have the potential to adversely affect primary and secondary productivity (Spence *et al.* 1996) and cover for juvenile salmonids (Bjornn and Reiser 1991). Instream work for this Project will take place during the in-water window for the area of July 1 to July 31. Due to the typically low flows in the Project area during this time, sedimentation rates are expected to be minimized. Disturbance of riparian vegetation will result from operation of heavy machinery near the stream and could lead to decreased shade, increased water temperatures, and decreased streambank stability until riparian vegetation is re-established.

Suspended sediment and turbidity influences on fish reported in the literature range from beneficial to detrimental. Elevated total suspended solids (TSS) have been reported to enhance cover conditions, reduce piscivorus fish/bird predation rates, and improve survival. Elevated TSS have also been reported to cause physiological stress, reduce growth, and adversely affect survival. Of key importance in considering the detrimental effects of TSS on fish are the frequency and the duration of the exposure, not just the TSS concentration. Juvenile salmonids tend to avoid streams that are chronically turbid, such as glacial streams or those disturbed by human activities, unless the fish need to traverse these streams along migration routes (Lloyd *et al.* 1987). Fish that remain in turbid waters experience reduced predation from piscivorus fish and birds (Gregory and Levings 1998). However, research shows that chronic exposure can cause physiological stress responses that can increase maintenance energy and reduce feeding and growth (Redding *et al.* 1987, Lloyd 1987, Servizi and Martens 1991).

There is a potential for fuel or other contaminant spills associated with use of heavy equipment in or near the stream. Operation of back-hoes, excavators, and other equipment requires the use of fuel, lubricants, *etc.*, which, if spilled into the channel of a waterbody or into the adjacent riparian zone, can injure or kill aquatic organisms. Petroleum-based contaminants, such as fuel, oil, and some hydraulic fluids, contain polycyclic aromatic hydrocarbons (PAHs), which can be acutely toxic to salmonids at high levels of exposure and can cause mortailty and have acute and chronic sublethal effects on aquatic organisms (Neff 1985). Instream construction will elevate the risk for chemical contamination of the aquatic environment within the action area. Because the potential for chemical contamination should be localized and brief, the probability of direct mortality is negligible. Timing in-water work to take place during the preferred in-water work period, refueling outside of riparian areas, and cleaning equipment before instream work will minimize the risk of chemical contamination.

Fish passage will most likely be disrupted to some degree during the construction period of 2 to 4 weeks. Although fish will theoretically be able to pass upstream and downstream through the bypass channel, the accelerated flow through this channel and the level of human activity occurring in the area will discourage juvenile and adult fish from using the bypass channel. The BA states that upstream fish passage is not expected during the construction activities. SR steelhead and SR spring/summer Chinook salmon smolts heading to the ocean will have already passed the action area before July. Most bull trout in the Catherine Creek watershed typically migrate upstream from the Project area seeking cool water before July, although their presence in the action area cannot be ruled out.

Habitat Effects of the Proposed Project

The proposed Project will result in some short- and long-term impacts to SR steelhead habitat, SR spring/summer Chinook salmon critical habitat, and bull trout habitat. As mentioned previously, disturbance of riparian areas will result in decreased shade, increased water temperatures, and decreased streambank stability until riparian vegetation is re-established. Some minor sedimentation of downstream spawning substrates is expected, but fine sediment will be flushed from the substrate during subsequent high flow events.

The rock cross vane will stop most bed load material during the year after it is installed. The BA states, "[the] structure is expected to pass bed load normally after approximately a year has passed." However, due to changes in the shape and dimensions of the Catherine Creek channel at the Project site, it is possible that some bedload will be shifted to downstream sites. These channel changes may also lead to acceleration of water velocities in the Project reach. Localized simplification of habitat including loss of side channel habitat, overhanging banks, and overhead vegetation will result from the partial removal of the mid-channel gravel bar and filling of side-channel habitat. New pool habitat will be created by scouring occurring downstream of the cross vane and J-hook structure.

The BA indicates that during periods of low flow in the summer and fall, the Oregon Water Resources Department (OWRD) watermaster adjusts the headgate at the SDS to allow at least 20 cfs of water to pass because there is a senior water user a short distance downstream with a 20 cfs OWRD water right. During July and August, stream flow in Catherine Creek is usually between 10 and 20 cfs at the Project site. Because at least 20 cfs of water needs to be left instream during low flow periods to satisfy a senior water right downstream, the effects of the increased SDS ditch volume are most likely minor, at least during summer and fall.

The alterations to the SDS will improve both juvenile and adult fish passage. The instream structures are designed to arrest downstream streambank erosion and reduce the amount of fine sediment being contributed to the stream by this erosion.

Fish Salvage

There will be direct effects on juvenile SR steelhead and juvenile or adult SR spring/summer Chinook salmon as well as on bull trout in the form of harm or harassment during the work area isolation and fish salvage operation. Fish will be removed from the instream isolation area by seining or electrofishing, which will cause stress. Stress approaching or exceeding the physiological tolerance limits of individual fish can impair reproductive success, growth, resistance to infectious diseases, and general survival (Wedemeyer *et al.* 1990). Many factors influence the relative effects of electrofishing on fish, including conductivity of water, depth of water, substrate, and size of the fish. Snyder (2003) reviews in detail the adverse effects that electrofishing can have on fish. Additionally, the amount of time needed to complete electrofishing within the sample area, the frequency of sampling through time, crew efficiency, and operator skill have been identified as factors influencing the magnitude of electrofishing effects. Mechanical injury is also possible during netting, holding, or transporting.

The small number of juvenile SR steelhead that may be affected by the fish salvage operation will not have population-level effects. Most adult SR spring/summer Chinook salmon pass through the Project area in May and June, but there is a chance that some fish will be passing through the Project area as late as July. Adult SR spring/summer Chinook salmon in the Project area are already under a great deal of stress at this time due to the high water temperatures. Any handling of fish could result in mortality. Bull trout also move upstream of the Project area in spring and early summer, but it is possible that some fish may still be in the Project area in early July.

2.1.6 Cumulative Effects

"Cumulative effects" are defined in 50 CFR 402.02 as those effects of "future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." The BA provided by the BPA does not specifically identify any cumulative effects. Information provided by other Federal agencies indicates the following cumulative effects are likely to occur in the action area.

Private timber harvests in Oregon are regulated by the Oregon Forest Practices Act. These regulations for private timber harvest and road building are less restrictive than those on National Forests. Timber harvest on private lands in the Upper Grande Ronde subbasin has generally increased in recent years. BAs from the Forest Service describe the adverse cumulative effects from proposed private timber harvests as high. One BA (US Forest Service 2004) states, "The lack of complete regulations and enforcement of existing regulations on private land timber harvests increases the likelihood of cumulative adverse effects."

Water withdrawal for irrigation and livestock grazing are likely to occur at present levels for the foreseeable future, resulting in portions of Catherine Creek being de-watered during summer and fall.

Between 1990 and 2000, the population of Union County increased by 3.9%.[2] Thus, NOAA Fisheries assumes that future private and state actions will continue within the action area, but at increasingly higher levels as population density climbs. Most future actions by the State of Oregon are described in the Oregon Plan for Salmon and Watershed measures, which includes a variety of programs designed to benefit salmon and watershed health.

2.1.7 Conclusion

NOAA Fisheries determines that, when the effects of the action addressed in this Opinion are added to the environmental baseline and cumulative effects occurring in the action area, they are not likely to jeopardize the continued existence of SR steelhead and SR spring/summer Chinook salmon. The Project will also not result in adverse modification of designated critical habitat for SR spring/summer Chinook salmon. The USFWS determines that when the effects of the action addressed in this Opinion are added to the environmental baseline and cumulative effects occurring in the action area, they are not likely to jeopardize the continued existence of bull trout.

The Services' conclusions are based on the following considerations: (1) All instream work will occur during the ODFW in-water work window for this area of July 1 to July 31, and instream work will be limited to the amount described in the BA; (2) disturbed areas will be replanted with native vegetation; (3) the increased capacity of the SDS to divert water from Catherine Creek should not result in a measurable decrease in stream flow during the low flow periods of summer and fall; and (4) a long-term improvement of fish passage in the action area will result from the proposed action. Thus, the proposed action is not expected to appreciably reduce the functioning of already impaired habitats or retard the long-term progress of impaired habitats toward proper functioning condition essential to the long-term survival and recovery at the population or DPS or ESU scales.

2.1.8 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species or to develop additional information. The Services believes that the following conservation recommendations should be implemented:

1. The BPA should conduct a comprehensive feasability study on methods to improve summer and fall stream flow in Catherine Creek. Methods considered should include

[2] U.S. Census Bureau, State and County Quickfacts, Union County, Oregon. Available at: http://quickfacts.census.govl

irrigation diversion consolidation, water rights leases or purchases, and conversion to more efficient irrigation systems.

2. BPA should fund measures to improve summer and fall stream flow.

Please notify the Services if the BPA carries out these recommendations so that we will be kept informed of actions that minimize or avoid adverse effects, and those that benefit species or their habitats.

2.1.9 Reinitiation of Consultation

As provided in 50 CFR 402.16, reinitiation of formal consultation is required if: (1) The amount or extent of taking specified in the incidental take statement is exceeded or is likely to be exceeded; (2) new information reveals effects of the action may affect listed species in a way not previously considered; (3) the action is modified in a way that causes an effect on listed species that was not previously considered; or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operation causing such take must cease, pending conclusion of the reinitiated consultation.

To reinitiate consultation with NOAA Fisheries, the BPA must contact the Habitat Conservation Division of NOAA Fisheries, Oregon State Habitat Office and refer to NOAA Fisheries No.: **2004/00523**. To reinitiate consultation with the USFWS, the BPA must contact the USFWS La Grande Field Office and refer to: **04-2651**.

2.2 Incidental Take Statement

The ESA at section 9 [16 USC 1538] prohibits take of endangered species. The prohibition of take is extended to threatened anadromous salmonids by section 4(d) rule [50 CFR 223.203]. Take of bull trout is prohibited without special exemption. Take is defined by the statute as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct” [16 USC 1532(19)]. Harm is defined by regulation as “an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavior patterns including breeding, spawning, rearing, migrating, feeding or sheltering” [50 CFR 222.102]. Harass is defined as “an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering” [50 CFR 17.3].

Incidental take is defined as “takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant” [50 CFR 402.02]. The ESA at section 7(o)(2) removes the prohibition from any incidental taking that is in compliance with the terms and conditions specified in a section 7(b)(4) incidental take statement [16 USC 1536].

An incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply to implement the reasonable and prudent measures.

2.2.1 Amount or Extent of the Take

The proposed action is reasonably certain to result in incidental take of SR steelhead, SR spring/summer Chinook salmon, and bull trout. The Services are reasonably certain the incidental take described here will occur because: (1) The listed species are known to occur in the action area; and (2) the proposed action is likely to cause impacts significant enough to cause death or injury, or impair feeding, breeding, migrating, or sheltering for the listed species.

Some level of incidental take is expected to result from injury or death of juvenile SR steelhead and adult SR spring/summer Chinook salmon or bull trout during instream work. The temporary increase in sediment and turbidity is expected to cause fish to avoid disturbed areas of the stream, both within and downstream from the Project area. Incidental take in the form of death or sublethal effects can occur if toxicants are introduced into the water. Incidental take in the form of harm is likely from riparian disturbance caused by the proposed Project. This incidental take will be reduced as newly-planted riparian vegetation is established and loose soil stabilizes.

Because of the inherent biological characteristics of aquatic species such as SR steelhead, SR spring/summer Chinook salmon and bull trout, take attributable to this action cannot be quantified by the number of fish harmed, harassed, or killed. In instances such as these, the Services designate a quantified habitat surrogate. The amount of habitat to be disturbed is an area approximately 360 feet by 20 feet of disturbed streambanks on each side of Catherine Creek at the Project site. Take caused by the proposed action could continue downstream to the extent of the turbidity plume generated, approximately one mile.

In addition, incidental take is expected during work area isolation and fish relocation. Fish will be captured during the relocation by seining and electofishing. The number of fish captured should not exceed 100 juvenile SR steelhead or SR spring/summer Chinook salmon and two adult SR spring/summer Chinook salmon. The number of juvenile salmon or steelhead killed should not exceed ten individuals. The number of adult salmon and steelhead killed should not exceed one fish. The number of bull trout captured should not exceed two fish. The number of bull trout killed should not exceed one fish.

This exemption from the take prohibition includes only take caused by the proposed action, within the action area as defined in this Opinion. This exemption from the take prohibition does not include take that may result from insufficient flows in Catherine Creek and other downstream waters.

2.2.2 Effect of Take

In this Opinion, NOAA Fisheries determines that the level of anticipated take is not likely to result in jeopardy to SR steelhead or SR spring/summer Chinook salmon. The USFWS has determined that the level of anticipated take is not likely to result in jeopardy to bull trout.

2.2.3 Reasonable and Prudent Measures

The Services believe that the following reasonable and prudent measures are necessary and appropriate to minimize the impact of incidental taking on the above species. The BPA, with respect to the proposed action described in this Opinion, shall:

1. Avoid or minimize the amount and extent of take resulting from general construction activities, SDS design, riparian disturbance, and in-water work required to complete the proposed action described in this Opinion.

2. Avoid or minimize the likelihood of incidental take from contaminant leaks and spills associated with the use of heavy equipment near and within watercourses.

3. Monitor the effects of the proposed action to determine the project's actual effects on listed fish (50 CFR 402.14 (i)(3)). Monitoring should detect adverse effects of the proposed action, assess the actual levels of incidental take in comparison with anticipated incidental take documented in the incidental take statement, and detect circumstances where the level of incidental take is exceeded.

2.2.4 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the action must be implemented in compliance with the following terms and conditions, which implement the reasonable and prudent measures described above for each category of activity. These terms and conditions are non-discretionary.

1. To implement reasonable and prudent measure #1 (general construction, riparian disturbance, and in-water work), the BPA shall ensure that:

    a. Minimum area. Confine construction impacts to the minimum area necessary to complete the Project.
    b. Timing of in-water work. Work below the bankfull elevation[3] will be completed between July 1 and July 31.

[3] 'Bankfull elevation' means the bank height inundated by a 1.5 to 2-year average recurrence interval and may be estimated by morphological features such average bank height, scour lines and vegetation limits.

c. Cessation of work. Cease Project operations under high flow conditions that may result in inundation of the Project area, except for efforts to avoid or minimize resource damage.

d. Preconstruction activity. Complete the following actions before significant[4] alteration of the Project area.

   i. Marking. Flag the boundaries of clearing limits associated with site access and construction to prevent ground disturbance of critical riparian vegetation, wetlands and other sensitive sites beyond the flagged boundary.

   ii. Emergency erosion controls. Ensure that silt fences and straw bales[5] for emergency erosion control are on site.

   iii. Temporary erosion controls. All temporary erosion controls will be in place and appropriately installed downslope from Project activity within the riparian area until site restoration is complete.

   iv. General erosion control. Practices will be carried out to prevent erosion and sedimentation associated with access roads, stream crossings, drilling sites, construction sites, borrow pit operations, haul roads, equipment and material storage sites, fueling operations, staging areas, and roads being decommissioned.

   v. Inspection of erosion controls. During construction, monitor instream turbidity and inspect all erosion controls daily during the rainy season and weekly during the dry season, or more often as necessary, to ensure the erosion controls are working adequately.[6]

      (1) If monitoring or inspection shows that the erosion controls are ineffective, mobilize work crews immediately to make repairs, install replacements, or install additional controls as necessary.

      (2) Remove sediment from erosion controls once it has reached 1/3 of the exposed height of the control.

e. Heavy Equipment. When heavy equipment will be used, the equipment selected will have the least adverse effects on the environment (*e.g.*, minimally-sized, low ground pressure equipment).

f. Site preparation. Conserve native materials for site restoration.

   i. If possible, leave native materials where they are found.

   ii. If materials are moved, damaged or destroyed, replace them with a functional equivalent during site restoration.

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[4] 'Significant' means an effect can be meaningfully measured, detected or evaluated.

[5] When available, certified weed-free straw or hay bales will be used to prevent introduction of noxious weeds.

[6] 'Working adequately' means that Project activities do not increase ambient stream turbidity by more than 10% above background 100 feet below the discharge, when measured relative to a control point immediately upstream from the turbidity causing activity.

iii. Stockpile any large wood,[7] native vegetation, weed-free topsoil, and native channel material displaced by construction for use during site restoration.

g. Earthwork. Complete earthwork (including drilling, excavation, dredging, filling and compacting) as quickly as possible.

i. Site stabilization. Stabilize all disturbed areas following any break in work unless construction will resume within four days.

ii. Source of materials. Obtain boulders, rock, woody materials and other natural construction materials used for the Project outside the riparian area.

iii. Excavated material. Remove all excavated material for the new channel from the 100-year floodplain.

h. Site restoration. Site restoration and cleanup, including protection of bare earth by seeding, planting, mulching and fertilizing, is done in the following manner:

i. All areas damaged by the construction activities will be restored to pre-work conditions including restoration of original streambank lines, and contours.

ii. All exposed soil surfaces, including construction access roads and associated staging areas, will be stabilized at finished grade with native herbaceous seeding and native woody vegetation as soon as possible during the appropriate planting season (immediately for seeding and the following fall or spring for woody plantings). On cut slopes steeper than 1 to 2, a tackified seed mulch will be used so that the seed does not wash away before germination and rooting occurs. In steep locations, consider using hydro-mulch applied at 1.5 times the normal rate.

iii. Disturbed areas will be planted with native vegetation specific to the project vicinity or the region where the project occurs, and will comprise a diverse assemblage of woody and herbaceous species.

iv. All plantings and seeding will be completed before July 1 of the following year.

v. Plantings in areas disturbed by construction activities will achieve an 80% survival success after 3 years.

(1) If success standard has not been achieved after 3 years, the BPA will develop an alternative plan, address temporal loss of function and remedy the issue.

(2) Plant establishment monitoring will continue and plans will be submitted to NOAA Fisheries until site restoration success has been achieved.

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[7] For purposes of this Opinion only, 'large wood' means a tree, log, or rootwad big enough to dissipate stream energy associated with high flows, capture bedload, stabilize streambanks, influence channel characteristics, and otherwise support aquatic habitat function, given the slope and bankfull channel width of the stream in which the wood occurs. See Oregon Department of Forestry and Oregon Department of Fish and Wildlife, *A Guide to Placing Large Wood in Streams*, May 1995 (www.odf.state.or.us/FP/RefLibrary/LargeWoodPlacemntGuide5-95.doc).

i. Pesticides and fertilizer. Do not apply fertilizer, herbicides, or other pesticides within 200 feet of any stream channel.

j. Isolation of in-water work area. Completely isolate the work area from the active flowing stream using inflatable bags, sandbags, sheet pilings, or similar materials.

k. Capture and release. Before and intermittently during pumping to isolate an in-water work area, attempt to capture and release fish from the isolated area using trapping, seining, electrofishing, or other methods as are prudent to minimize risk of injury.

   i. The entire capture and release operation must be conducted or supervised by a fishery biologist experienced with work area isolation and competent to ensure the safe handling of all ESA-listed fish.
   ii. Do not use electrofishing if water temperatures exceed 18°C.
   iii. If electrofishing equipment is used to capture fish, comply with NOAA Fisheries' electrofishing guidelines.[8]
   iv. Handle ESA-listed fish with extreme care, keeping fish in water to the maximum extent possible during seining and transfer procedures to prevent the added stress of out-of-water handling.
   v. Transport fish in aerated buckets or tanks.
   vi. Release fish into a safe release site as quickly as possible, and as near as possible to capture sites.
   vii. Do not transfer ESA-listed fish to anyone except NOAA Fisheries or the USFWS.
   viii. Obtain all other Federal, state, and local permits necessary to conduct the capture and release activity.
   ix. Allow NOAA Fisheries or USFWS representatives to accompany the capture team during the capture and release activity, and to inspect the team's capture and release records and facilities.

l. SDS design. Design the modifications to the SDS in the following manner:

   i. Meet NOAA Fisheries draft fish passage criteria.[9]
   ii. Install and maintain a stream flow gauge, measuring device, or headgate with a measuring device that can be used to monitor stream flow diversion into the irrigation ditch associated with the SDS.

2. To implement reasonable and prudent measure #2 (pollution control), the BPA shall ensure that:

   a. Pollution Control Plan. Prepare and carry out a pollution and erosion control plan to prevent pollution caused by surveying or construction operations. The plan must be available for inspection on request by the Services.

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[8] National Marine Fisheries Service, *Backpack Electrofishing Guidelines* (December 1998) (http://www.nwr.noaa.gov/1salmon/salmesa/pubs/electrog.pdf).

[9] available at: http://www.nwr.noaa.gov/1hydrop/hydroweb/docs/Passagecriteria.extrevdraft.pdf

i. Plan Contents. The pollution and erosion control plan will contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations.

(1) The name and address of the party(s) responsible for accomplishment of the pollution and erosion control plan.

(2) A description of any regulated or hazardous products or materials that will be used for the Project, including procedures for inventory, storage, handling, and monitoring.

(3) A spill containment and control plan with notification procedures, specific cleanup and disposal instructions for different products, quick response containment and cleanup measures that will be available on the site, proposed methods for disposal of spilled materials, and employee training for spill containment.

(4) Practices will be carried out to prevent construction debris from dropping into any stream or waterbody, and to remove any material that does drop with a minimum disturbance to the streambed and water quality.

ii. Vehicle and material staging. Store construction materials and fuel, operate, maintain, and store vehicles as follows.

(1) To reduce the staging area and potential for contamination, ensure that only enough supplies and equipment to complete a specific job will be stored on site.

(2) Complete vehicle staging, cleaning, maintenance, refueling, and fuel storage in a vehicle staging area outside riparian areas.

(3) Inspect all vehicles operated within riparian areas daily for fluid leaks before leaving the vehicle staging area. Repair any leaks detected in the vehicle staging area before the vehicle resumes operation. Document inspections in a record that is available for review on request by the Services.

b. Construction discharge water. Treat all discharge water created by construction (*e.g.*, pumping for work area isolation, vehicle wash water) as follows:

i. Water quality. Design, build and maintain facilities to collect and treat all construction discharge water using the best available technology applicable to site conditions. Provide treatment to remove debris, nutrients, sediment, petroleum hydrocarbons, metals and other pollutants likely to be present.

ii. Discharge velocity. If construction discharge water is released using an outfall or diffuser port, velocities may not exceed 4 feet per second, and the maximum size of any aperture may not exceed one inch.

iii. Pollutants. Do not allow pollutants including green concrete, contaminated water or silt to contact any wetland or the two-year floodplain.

3. To implement reasonable and prudent measure #3 (monitoring), the BPA shall:

a. Reporting. Within one year of Project completion, the BPA will submit a monitoring report to the Services describing the BPA's success in meeting the terms and conditions contained in this Opinion. Include the following information:

i. Project identification
   (1) Project name.
   (2) Type of activity.
   (3) Project location, by 6th field HUCs and by latitude and longitude as determined from the appropriate USGS 7-minute quadrangle map.
   (4) BPA contact person.
   (5) Starting and ending dates for work completed.

ii. Photo documentation. Photos of habitat conditions at the project and any compensation site(s), before, during, and after Project completion.[10]
   (1) Include general views and close-ups showing details of the Project and Project area, including pre- and post- construction.
   (2) Label each photo with date, time, project name, photographer's name, and a comment about the subject.

iii. Other data. Additional project-specific data, as appropriate.
   (1) Work cessation. Dates work ceased due to high flows, if any.
   (2) Fish screen. Evidence of compliance with NOAA Fisheries' fish screen criteria.
   (3) Pollution control. A summary of pollution and erosion control inspections, including any erosion control failure, contaminant release, and correction effort.
   (4) Site preparation.
      (a) Total cleared area – riparian and upland.
      (b) Total new impervious area.
   (5) Streambank protection.
      (a) Type and amount of materials used.
      (b) Project size – one bank or two, width and linear feet.
   (6) Site restoration. Photo or other documentation that site restoration performance standards were met.
   (7) Long-term habitat loss. The same elements apply as for monitoring site restoration.

b. Downstream bedload deposition. Monitoring areas downstream of the Project area to determine if deposition of streambed material is causing habitat effects not considered in this Opinion. Complete the following.

[10] Relevant habitat conditions may include characteristics of channels, eroding and stable streambanks in the Project area, riparian vegetation, water quality, flows at base, bankfull and over-bankfull stages, and other visually discernable environmental conditions at the Project area, and upstream and downstream from the Project.

i. Survey from Project site to 2 miles downstream to identify the location of potential bedload depositional areas that could receive bedload material being transported through the Project area.

ii. Monitor those sites for 5 years to determine if alterations to bedload depositional patterns caused by the Project are resulting in effects beyond those considered in this Opinion.

c. Effectiveness monitoring. Gather any other data or analyses the BPA deems necessary or helpful to complete an assessment of habitat trends in stream and riparian conditions as a result of this Project.

d. Lethal take. If a sick, injured, or dead specimen of a threatened or endangered salmon or steelhead is found, the finder must notify the Vancouver Field Office of NOAA Fisheries Law Enforcement at (360) 418-4246. If a sick, injured, or dead specimen of bull trout is found the finder must contact USFWS Law Enforcement Office, at 9025 SW Hillman Court, Suite 3134, Wilsonville, OR 97070; phone: 503-682-6131. The finder must take care in handling sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

e. Report submission. Submit a copies of the report to the Services at:

Oregon State Director
Habitat Conservation Division
National Marine Fisheries Service
Attn: **2004/00523**
525 NE Oregon Street
Portland, OR 97232

Field Supervisor
US Fish and Wildlife Service
La Grande Field Office
Attn: **04-2651**
3502 Highway 30
La Grande, OR 98750

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

3.1 Background

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires the inclusion of EFH descriptions in Federal fishery management plans. In addition, the MSA requires Federal agencies to consult with NOAA Fisheries on activities that would adversely affect EFH.

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting the definition of EFH: "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; “necessary” means the habitat required to support a sustainable fishery and the managed species’ contribution to a healthy ecosystem; and “spawning, breeding, feeding, or growth to maturity” covers a species’ full life cycle (50 CFR 600.110).

Section 305(b) of the MSA (16 USC 1855(b)) requires that:

- Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH;

- NOAA Fisheries shall provide conservation recommendations for any Federal or state activity that may adversely affect EFH;

- Federal agencies shall within 30 days after receiving conservation recommendations from NOAA Fisheries provide a detailed response in writing to NOAA Fisheries regarding the conservation recommendations. The response shall include a description of measures proposed by the agency for avoiding, mitigating or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the conservation recommendations of NOAA Fisheries, the Federal agency shall explain its reason for not following the recommendations.

The MSA requires consultation for all actions that may adversely affect EFH, and does not distinguish between actions within EFH and actions outside EFH. Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside EFH, such as upstream and upslope activities, that may have an adverse effect on EFH. Therefore, EFH consultation with NOAA Fisheries is required by Federal agencies undertaking, permitting or funding activities that may adversely affect EFH, regardless of its location.

3.2 Identification of EFH

The Pacific Fisheries Management Council (PFMC) has designated EFH for three species of Pacific salmon: Chinook (*Oncorhynchus tshawytscha*); coho (*O. kisutch*); and Puget Sound pink salmon (*O.gorbuscha*) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other waterbodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream from certain impassable man-made barriers (as identified by the PFMC), and longstanding, naturally-impassable barriers (*e.g.*, natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the *Pacific Coast Salmon Plan* (PFMC 1999). Assessment of potential adverse effects on these species’ EFH from the proposed action is based on this information.

3.3 Proposed Actions

The proposed action is detailed above in section 1.2 of the ESA portion of this Opinion. The action area is in the Catherine Creek watershed within the Upper Grande Ronde subbasin. This area has been designated as EFH for various life stages of Chinook and coho salmon.

3.4 Effects of Proposed Action

The effects on Chinook and coho salmon habitat are the same as those for SR steelhead and SR spring/summer Chinook and are described in detail in section 2.1.5 of this document. The proposed action may result in short-term adverse effects on a variety of habitat parameters. These adverse effects are:

1. Riparian disturbance from accessing construction area and construction activities performed from the bank.

2. Increased sedimentation from instream construction activities.

3.5 Conclusion

NOAA Fisheries believes that the proposed action may adversely affect EFH for Chinook salmon and coho salmon.

3.6 EFH Conservation Recommendations

Pursuant to section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations for any Federal or state agency action that would adversely affect EFH. The conservation measures proposed for the project by the BPA, all of the terms and conditions contained in section 2.2.3 are applicable to salmon EFH, except those related to in-water work timing, fish salvage, and the disposition of any individual fish killed or injured during completion of the project. Therefore, NOAA Fisheries incorporates each of those measures here as EFH conservation recommendations.

3.7 Statutory Response Requirement

The MSA (section 305(b)) and 50 CFR 600.920(j) requires the BPA to provide a written response to NOAA Fisheries' EFH conservation recommendations within 30 days of its receipt of this letter. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. If the response is inconsistent with NOAA Fisheries' conservation recommendations, the BPA shall explain its reasons for not following the recommendations.

3.8 Supplemental Consultation

The BPA must reinitiate EFH consultation with NOAA Fisheries if either the action is substantially revised or new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR 600.920). The BPA must reinitiate EFH consultation if the proposed action has not been implemented within 5 years past the signature date of this document.

4. LITERATURE CITED

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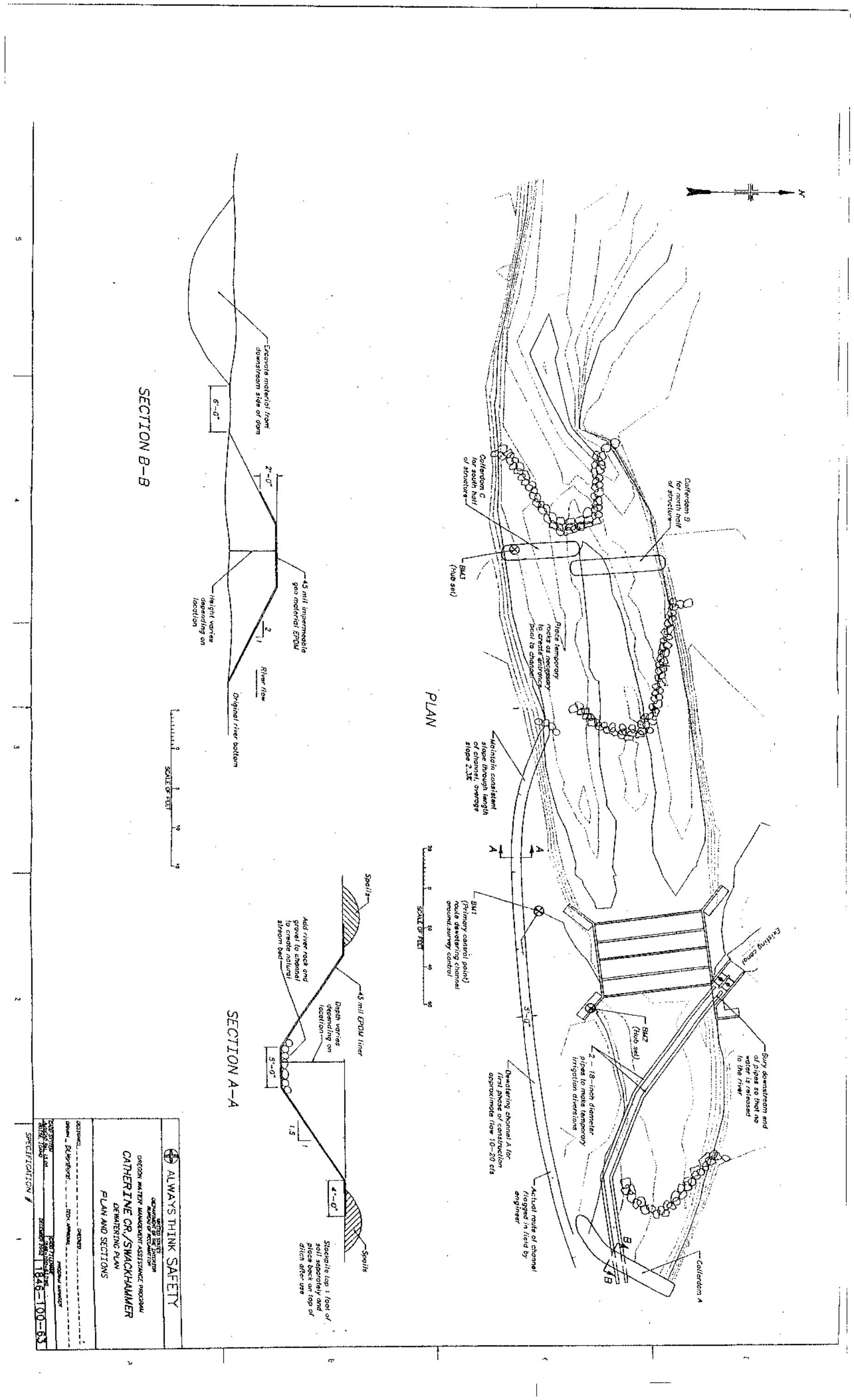
Appendix A
Diagrams of the Proposed Project

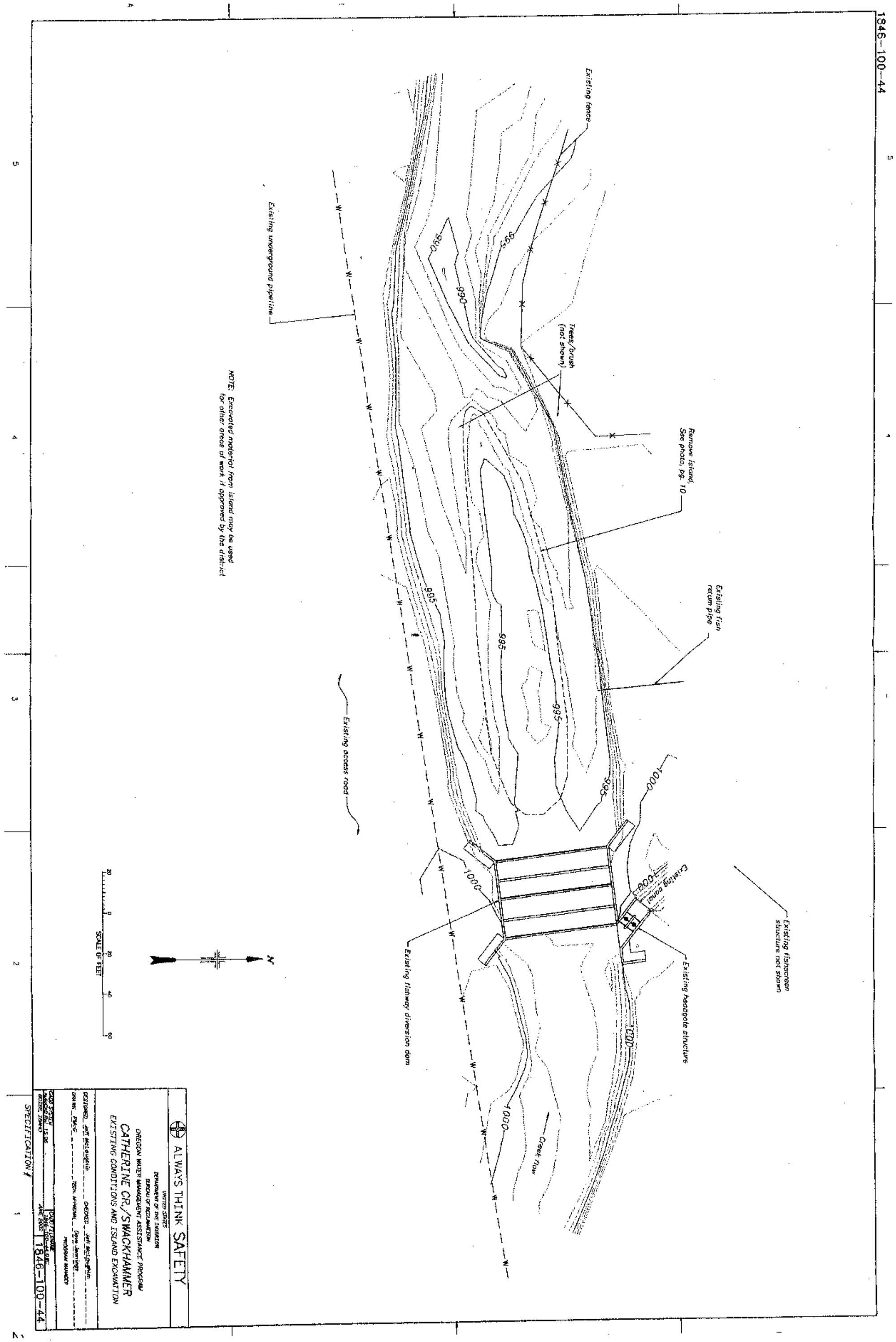
Appendix A - Diagrams of the Proposed Project

Figure 1. Dewatering plan (reprinted from BA)



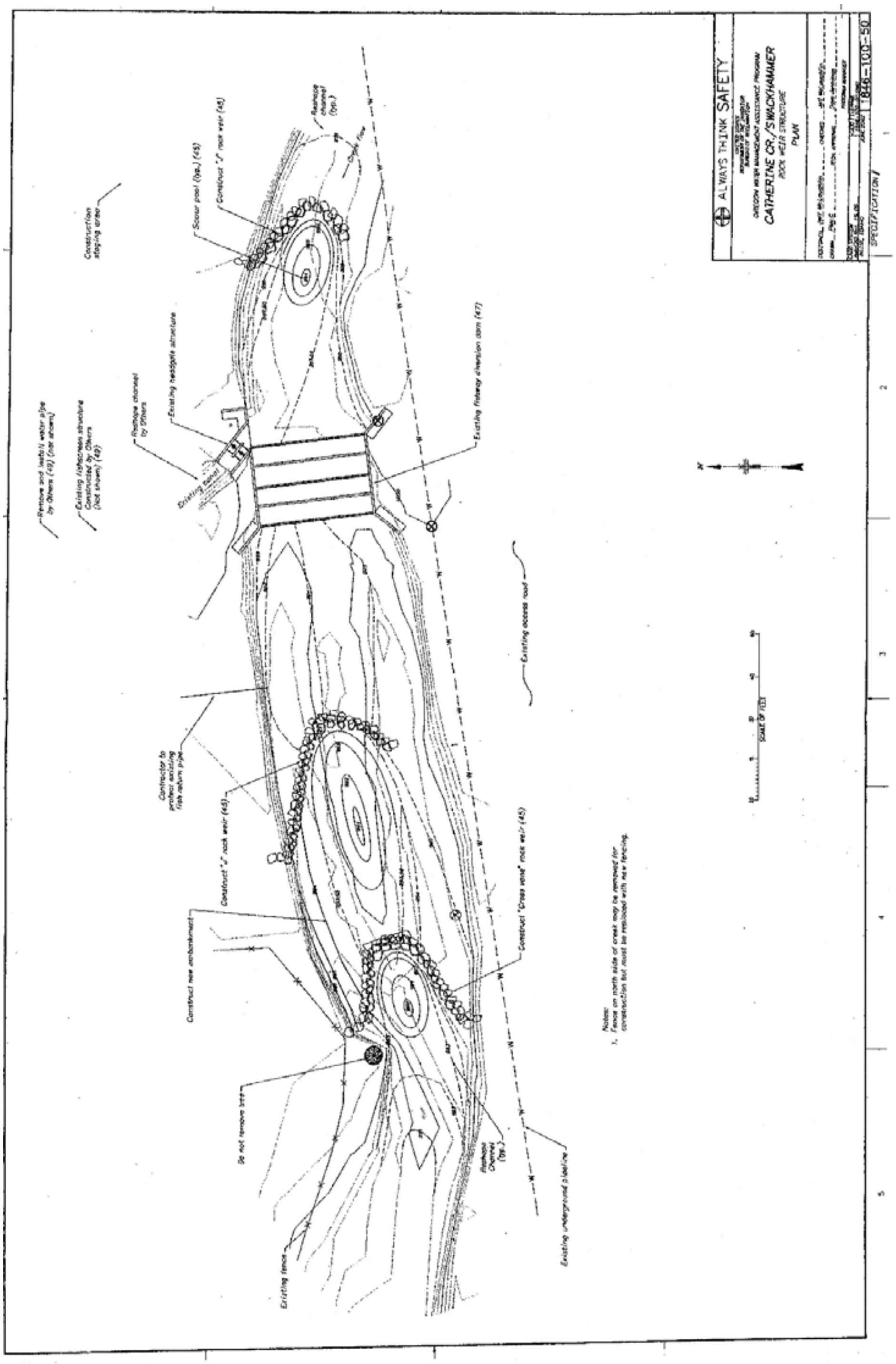
Appendix A - Diagrams of the Proposed Project

Figure 2. Current condition and gravel bar excavation (reprinted from BA)



Appendix A - Diagrams of the Proposed Project

Figure 3. Rock Weir Structures (Reprinted from BA)



Appendix B
Status of the Species, Bull Trout

Appendix B - Status of the Species, Bull Trout

Taxonomy

The bull trout (*Salvelinus confluentus*, family Salmonidae) is a char native to the Pacific Northwest and western Canada, first described as *Salmo spectabilis* by Girard in 1856 from a specimen collected on the lower Columbia River, and subsequently described as *Salmo confluentus* and *Salvelinus malma* (Cavender 1978). Bull trout and Dolly Varden (*Salvelinus malma*) were previously considered a single species (Cavender 1978, Bond 1992). Cavender (1978) presented morphometric, meristic, osteological, and distributional evidence to document specific distinctions between Dolly Varden and bull trout. Bull trout and Dolly Varden were formally recognized as separate species by the American Fisheries Society in 1980 (Robins *et al.* 1980). Although bull trout and Dolly Varden co-occur in several northwestern Washington river drainages, there is little evidence of introgression (Haas and McPhail 1991), and the two species appear to be maintaining distinct genomes (Leary *et al.* 1993, Williams *et al.* 1995, Kanda *et al.* 1997, Spruell and Allendorf 1997). Lastly, the bull trout and the Dolly Varden each appear to be more closely related genetically to other species of *Salvelinus* than they are to each other (Grewe *et al.* 1990, Pleyte *et al.* 1992, Crane *et al.* 1994, Phillips *et al.* 1995). For example, the bull trout is most closely related to the Japanese char (*S. leucomaenis*) whereas the Dolly Varden is most closely related to the Arctic char (*S. alpinus*).

Physical Description

The bull trout is a long, slender fish with a large head and jaws relative to its body size. Its tail fin is only slightly forked, and even less so in young fish. Bull trout coloration can be variable, but generally, the body's background color is gray infused with green. Bull trout found in lakes may be silvery grey. The body is covered with small white and/or pale yellowish spots with intermingling pink or red spots that not be always be present. The ventral region can range from white to orange. Bull trout typically have 15 to 19 gill rakers, 63 to 66 vertebrae, and 22 to 35 pyloric caeca. Bull trout of large size can be differentiated from Dolly Varden with bull trout having a larger head and jaws in addition to the head being more flat. Bull trout have spotless fins with the lower fins having white anterior borders. The spotless fin characteristic of bull trout is often used by fisheries agencies to help promote angler identification of bull trout versus other fish, such as brook trout (*Salvelinus fontinalis*) (Behnke 2002).

Distribution

The historical range of the bull trout includes major river basins in the Pacific Northwest at about 41 to 60^{O} North latitude, from the southern limits in the McCloud River in northern California and the Jarbidge River in Nevada to the headwaters of the Yukon River in the Northwest Territories, Canada (Cavender 1978, Bond 1992). To the west, the bull trout's range includes Puget Sound, various coastal rivers of British Columbia, Canada, and southeast Alaska (Bond 1992). Bull trout occur in portions of the Columbia River and tributaries within the basin, including its headwaters in Montana and Canada. Bull trout also occur in the Klamath River basin of south-central Oregon. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta and Montana, and in the MacKenzie River system in Alberta and British Columbia, Canada, (Cavender 1978, Brewin *et al.* 1997).

Listing History

On June 10, 1998, the Service issued a final rule listing the Columbia River and Klamath River populations of bull trout as threatened (63 FR 31647) under the authority of the ESA of 1973. This decision conferred full protection of the ESA on bull trout occurring in 4 northwestern states. The Jarbidge River population was listed as threatened on April 8, 1999 (64 FR 17110). The Coastal-Puget Sound and St. Mary-Belly River populations were listed as threatened on November 1, 1999 (64 FR 58910), which resulted in all bull trout in the coterminous United States being listed as threatened. The five populations discussed above are listed as distinct population segments, *i.e.*, they meet the joint policy of the U.S. Fish and Wildlife Service and NOAA Fisheries regarding the recognition of distinct vertebrate populations (61 FR 4722).

The Service proposed to designate critical habitat for the bull trout on November 29, 2002 (67 FR 71235).

DPS and Population Units

Population units of bull trout exist in which all fish share an evolutionary legacy and which are significant from an evolutionary perspective (Spruell *et al.* 1999). These population units can range from a local population to multiple populations, and theoretically should represent a DPS. Although such population units are difficult to characterize, genetic data have provided useful information on bull trout population structure. For example, genetic differences between the Klamath River and Columbia River populations of bull trout were revealed in 1993 (Leary *et al.* 1993). The boundaries of the five listed DPSs of bull trout are based largely on this 1993 information.

Since the bull trout was listed, additional genetic analyses have suggested that its populations may be organized on a finer scale than previously thought. Data have revealed genetic differences between coastal populations of bull trout, which includes the lower Columbia River and Fraser River, and inland populations in the upper Columbia River and Fraser River drainages (Williams *et al.* 1997, Taylor *et al.* 1999). There is also an apparent genetic differentiation between inland populations within the Columbia River basin. This differentiation occurs between the: (1) Mid-Columbia River (John Day, Umatilla) and lower Snake River (Walla Walla, Clearwater, Grande Ronde, Imnaha rivers, *etc.*) populations; and the (2) upper Columbia River (Methow, Clark Fork, Flathead River, *etc.*) and upper Snake River (Boise River, Malheur River, Jarbidge River, *etc.*) populations (Spruell *et al.* 2003). Genetic data indicate that bull trout inhabiting the Deschutes River drainage of Oregon are derived from coastal populations and not from inland populations in the Columbia River basin (Leary *et al.* 1993, Williams *et al.* 1997, Spruell and Allendorf 1997, Taylor *et al.* 1999, Spruell *et al.* 2003). In general, evidence since the time of listing suggests a need to further evaluate the distinct population segment structure of bull trout DPSs.

Life History

Bull trout exhibit both resident and migratory life-history strategies (Rieman and McIntyre 1993). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. Migratory bull trout spawn in tributary streams where juvenile fish rear one to four years before migrating to either a lake (adfluvial form), river (fluvial form)

(Fraley and Shepard 1989, Goetz 1989), or in certain coastal areas, to saltwater (anadromous) (Cavender 1978, McPhail and Baxter 1996, WDFW *et al.* 1997). Resident and migratory life-history forms may be found together but it is unknown if they represent a single population or separate populations (Rieman and McIntyre 1993). Either form may give rise to offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993). The multiple life-history strategies found in bull trout populations represent important diversity (both spatial and genetic) that help protect these populations from environmental stochasticity.

The size and age of bull trout at maturity depends on the life-history strategy and habitat limitations. Resident fish tend to be smaller than migratory fish at maturity and produce fewer eggs (Fraley and Shepard 1989, Goetz 1989). Resident adults usually range from 150 to 300 millimeters (6 to 12 inches) total length (TL). Migratory adults however, having lived for several years in larger rivers or lakes and feeding on other fish, grow to a much larger size and commonly reach 600 millimeters (24 inches) TL or more (Pratt 1985, Goetz 1989). The largest verified bull trout was a 14.6-kilogram (32-pound) adfluvial fish caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982). Size differs little between life-history forms during their first years of life in headwater streams, but diverges as migratory fish move into larger and more productive waters (Rieman and McIntyre 1993).

Ratliff (1992) reported that bull trout under 100 mm (4 inches) in length were generally only found in the vicinity of spawning areas, and that fish over 100 mm were found downstream in larger channels and reservoirs in the Metolius River basin. Juvenile migrants in the Umatilla River were primarily 100 to 200 mm long (4 to 8 inches) in the spring and 200 to 300 mm long (8 to 12 inches) in October (Buchanan *et al.* 1997). The age at migration for juveniles is variable. Ratliff (1992) reported that most juveniles reached a size to migrate downstream at age 2, with some at ages 1 and 3 years. Pratt (1992) had similar findings for age-at-migration of juvenile bull trout from tributaries of the Flathead River. The seasonal timing of juvenile downstream migration appears similarly variable.

Bull trout normally reach sexual maturity in 4 to 7 years, and may live longer than 12 years. The species is iteroparous (*i.e.*, can spawn multiple times in their lifetime) and adults may spawn each year or in alternate years (Batt 1996). Repeat-spawning frequency and post-spawning mortality are not well documented (Leathe and Graham 1982, Fraley and Shepard 1989, Pratt 1992, Rieman and McIntyre 1996) but post-spawn survival rates are believed to be high.

Bull trout typically spawn from late August to November during periods of decreasing water temperatures (below 9^{O} Celsius/48^{O} Fahrenheit). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989, Pratt 1992, Rieman and McIntyre 1996). Migratory bull trout frequently begin spawning migrations as early as April and have been known to move upstream as far as 250 kilometers (km) (155 miles) to spawning grounds in Montana (Fraley and Shepard 1989, Swanberg 1997). In Idaho, bull trout moved 109 km (67.5 miles) from Arrowrock Reservoir to spawning areas in the headwaters of the Boise River (Flatter 1998). In the Blackfoot River, Montana, bull trout began spring spawning migrations in response to increasing temperatures (Swanberg 1997). Depending on water temperature, egg incubation is normally 100 to 145 days (Pratt 1992), and after hatching, juveniles remain in the substrate. Time from egg deposition to emergence of fry may surpass 220 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992, Ratliff and Howell 1992).

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macro-zooplankton, and small fish (Boag 1987, Goetz 1989, Donald and Alger 1993). Adult migratory bull trout feed on various fish species (Leathe and Graham 1982, Fraley and Shepard 1989, Brown 1992, Donald and Alger 1993). In coastal areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) in the ocean (WDFW *et al.* 1997).

Habitat Affinities

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993). Habitat components that influence the species' distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and availability of migratory corridors (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Howell and Buchanan 1992; Pratt 1992; Rieman and McIntyre 1993, 1995; Rich 1996; Watson and Hillman 1997). Watson and Hillman (1997) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993), individuals of this species should not be expected to simultaneously occupy all available habitats (Rieman *et al.*1997a).

Bull trout are found primarily in cold streams, although individual fish are found in larger, warmer river systems throughout the Columbia River basin (Fraley and Shepard 1989; Rieman and McIntyre 1993, 1995; Buchanan and Gregory 1997; Rieman *et al.* 1997a). Water temperature above 15^{O} Celsius (59^{O} Fahrenheit) is believed to limit bull trout distribution, a limitation that may partially explain the patchy distribution within a watershed (Fraley and Shepard 1989, Rieman and McIntyre 1995).

Spawning areas are often associated with cold-water springs, groundwater infiltration, and the streams with the coldest summer water temperatures in a given watershed (Pratt 1992, Rieman and McIntyre 1993, Rieman *et al.* 1997a, Baxter *et al.* 1999). Water temperatures during spawning generally range from 5 to 9^{O} Celsius (41 to 48^{O} Fahrenheit) (Goetz 1989). The requirement for cold water during egg incubation has generally limited the spawning distribution of bull trout to high elevations in areas where the summer climate is warm. Rieman and McIntyre (1995) found in the Boise River basin that no juvenile bull trout were present in streams below 1613 m (5000 feet). Similarly, in the Sprague River basin of south-central Oregon, Ziller (1992) found in four streams with bull trout that "numbers of bull trout increased and numbers of other trout species decreased as elevation increased. In those streams, bull trout were only found at elevations above 1774 m [5500 feet]."

Goetz (1989) suggested optimum water temperatures for rearing bull trout of about 7 to 8^{O} Celsius (44 to 46^{O} Fahrenheit) and for egg incubation of 2 to 4^{O} Celsius (35 to 39^{O} Fahrenheit). For Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water 8 to 9^{O} Celsius (46 to 48^{O} Fahrenheit), within a temperature gradient of 8 to 15^{O} Celsius (46 to 60^{O} Fahrenheit)] available in a plunge pool.

In Nevada, adult bull trout have been collected at sites with a water temperature of 17.2^{O} Celsius (63^{O} Fahrenheit) in the West Fork of the Jarbidge River (S. Werdon, *pers. comm.*, 1998) and have been observed in Dave Creek where maximum daily water temperatures were 17.1 to 17.5^{O} Celsius (62.8 to 63.6^{O} Fahrenheit) (Werdon, *in litt.* 2001). In the Little Lost River, Idaho, bull trout have been collected in water having temperatures up to 20^{O} Celsius (68^{O} Fahrenheit); however, these fish made up less than 50 % of all salmonids when maximum summer water temperature exceeded 15^{O} Celsius (59^{O} Fahrenheit) and less than 10 % of all salmonids when temperature exceeded 17^{O} Celsius (63^{O} Fahrenheit)(Gamett 1999).

All life-history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989, Goetz 1989, Hoelscher and Bjornn 1989, Sedell and Everest 1991, Pratt 1992, Thomas 1992, Rich 1996, Sexauer and James 1997, Watson and Hillman 1997). Jakober (1995) observed bull trout overwintering in deep beaver ponds or pools containing large woody debris in the Bitterroot River drainage, Montana, and suggested that, because of the need to avoid anchor ice to survive, suitable winter habitat may be more restricted than summer habitat. Maintaining bull trout habitat requires stability of stream channels and of flow (Rieman and McIntyre 1993). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard 1989, Pratt 1992, Pratt and Huston 1993).

Preferred bull trout spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989). In the Swan River, Montana, abundance of bull trout redds (spawning areas) was positively correlated with the extent of bounded alluvial valley reaches, which are likely areas of groundwater to surface water exchange (Baxter *et al.* 1999). Survival of bull trout embryos planted in stream areas of groundwater upwelling used by bull trout for spawning were significantly higher than embryos planted in areas of surface-water recharge not used by bull trout for spawning (Baxter and McPhail 1999). Pratt (1992) indicated that increases in fine sediment reduce egg survival and emergence.

Migratory corridors link seasonal habitats for all bull trout life-history forms. For example, in Montana, migratory bull trout make extensive migrations in the Flathead River system (Fraley and Shepard 1989), and resident bull trout in tributaries of the Bitterroot River move downstream to overwinter in tributary pools (Jakober 1995). The ability to migrate is important to the persistence of bull trout (Rieman and McIntyre 1993, M. Gilpin, *in litt.* 1997, Rieman *et al.* 1997a). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed, or stray, to non-natal streams. Local bull trout populations that are extirpated by catastrophic events may also become re-established by migrants.

Population Dynamics

Although bull trout are widely distributed over a large geographic area, they exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993). Increased habitat fragmentation reduces the amount of available habitat and increases isolation from other populations of the same species (Saunders *et al.* 1991). Burkey (1989) concluded that when species are isolated by fragmented habitats, low rates of population growth are typical in local populations and their probability of extinction is directly related to the degree of isolation and fragmentation. Without sufficient immigration, growth for local populations may be low and probability of extinction high (Burkey 1989, 1995).

Metapopulation concepts of conservation biology theory have been suggested relative to the distribution and characteristics of bull trout, although empirical evidence is relatively scant (Rieman and McIntyre 1993, Dunham and Rieman 1999, Rieman and Dunham 2000). A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994). For inland bull trout, metapopulation theory is likely most applicable at the watershed scale where habitat consists of discrete patches or collections of habitat capable of supporting local populations; local populations are for the most part independent and represent discrete reproductive units; and long-term, low-rate dispersal patterns among component populations influences the persistence of at least some of the local populations (Rieman and Dunham 2000). Ideally, multiple local populations distributed throughout a watershed provide a mechanism for spreading risk because the simultaneous loss of all local populations is unlikely. However, habitat alteration, primarily through the construction of impoundments, dams, and water diversions has fragmented habitats, eliminated migratory corridors, and in many cases isolated bull trout in the headwaters of tributaries (Rieman *et al.* 1997a, Dunham and Rieman 1999, Spruell *et al.* 1999, Rieman and Dunham 2000). Accordingly, human-induced factors as well as natural factors affecting bull trout distribution have likely limited the expression of the metapopulation concept for bull trout to patches of habitat within the overall distribution of the species (Dunham and Rieman 1999). However, despite the theoretical fit, the relatively recent and brief time period during which bull trout investigations have taken place does not provide certainty as to whether a metapopulation dynamic is occurring (*e.g.*, a balance between local extirpations and recolonizations) across the range of bull trout or whether the persistence of bull trout in large or closely interconnected habitat patches (Dunham and Rieman 1999) is simply reflective of a general deterministic trend towards extinction of the species where the larger or interconnected patches are relics of historically wider distribution (Rieman and Dunham 2000). Recent research (Whiteley *et al.* 2003) does, however, provide stronger genetic evidence for the presence of a metapopulation process for bull trout, at least in the Boise River basin of Idaho.

Reasons for Listing

Bull trout distribution, abundance, and habitat quality have declined rangewide (Bond 1992, Schill 1992, Thomas 1992, Ziller 1992, Rieman and McIntyre 1993, Newton and Pribyl 1994, IDFG *in litt.* 1995, McPhail and Baxter 1996). Several local extirpations have been documented, beginning in the 1950's (Rode 1990, Ratliff and Howell 1992, Donald and Alger 1993, Goetz 1994, Newton and Pribyl 1994, Berg and Priest 1995, Light *et al.* 1996, Buchanan *et al.* 1997, WDFW 1998). Bull trout were extirpated from the southernmost portion of their historic range, the McCloud River in California, around 1975 (Moyle 1976, Rode 1990). Bull trout have been functionally extirpated (*i.e.*, few individuals may occur there but do not constitute a viable population) in the Coeur d'Alene River basin in Idaho and in the Lake Chelan and Okanogan River basins in Washington (USFWS 1998).

These declines result from the combined effects of habitat degradation and fragmentation, the blockage of migratory corridors; poor water quality, angler harvest and poaching, entrainment (process by which aquatic organisms are pulled through a diversion or other device) into diversion channels and dams, and introduced nonnative species. Specific land and water management activities that depress bull trout populations and degrade habitat include dams and other diversion structures, forest management practices, livestock grazing, agriculture, agricultural diversions, road construction and maintenance, mining, and urban and rural development (Beschta *et al.* 1987; Chamberlain *et al.* 1991; Furniss *et al.* 1991; Meehan 1991; Nehlsen *et al.* 1991; Sedell and Everest 1991; Craig and Wissmar 1993; Frissell 1993; Henjum *et al.* 1994; McIntosh *et al.* 1994; Wissmar *et al.* 1994; MBTSG 1995a-e, 1996a-f; Light *et al.* 1996; USDA and USDI 1995, 1996, 1997).

<u>Rangewide Trend</u>
In the rules listing bull trout as threatened, the Service identified subpopulations (*i.e.*, isolated groups of bull trout thought to lack two-way exchange of individuals), for which status, distribution, and threats to bull trout were evaluated. Because habitat fragmentation and barriers have isolated bull trout throughout their current range, a subpopulation was considered a reproductively isolated group of bull trout that spawns within a particular river or area of a river system. Overall, 187 subpopulations were identified in the 5 distinct population segments, 7 in the Klamath River, 141 in the Columbia River, 1 in the Jarbidge River, 34 in the Coastal-Puget Sound, and 4 in the St. Mary-Belly River populations. No new subpopulations have been identified and no subpopulations have been lost since listing. More detailed information on the range-wide trend of the bull trout is being developed for the 5-year status review and is not yet available.

<u>New Threats</u>
Since listing, no substantial new threats have been identified.

<u>Consulted-on Effects</u>
Consulted-on effects are those effects that have been analyzed through section 7 consultation as reported in a biological opinion. These effects are an important component of objectively characterizing the current condition of the species. To assess consulted-on effects to bull trout, we analyzed all of the biological opinions received by the Region 1 and Region 6 Offices, from the time of listing until August 2003; this summed to 137 biological opinions. Of these, 124 biological opinions (91 %) applied to activities affecting bull trout in the Columbia basin DPS, 12 biological opinions (9 %) applied to activities affecting bull trout in the Coastal-Puget Sound DPS, 7 biological opinions (5 %) applied to activities affecting bull trout in the Klamath basin

DPS, and 1 biological opinion (<1 %) applied to activities affecting the Jarbidge and St. Mary Belly DPSs (Note: these percentages do not add to 100, because several biological opinions applied to more than one DPS). The geographic scale of these consultations varied from individual actions (*e.g.*, construction of a bridge or pipeline) within one basin to multiple-project actions occurring across several basins.

Our analysis showed that we consulted on a wide array of actions which had varying level of effects. Many of the actions resulted in only short-term adverse effects – some with long-term beneficial effects. Some of the actions resulted in long-term adverse effects. No actions that have undergone consultation were found to appreciably reduce the likelihood of survival and recovery of the bull trout. Furthermore no actions that have undergone consultation were anticipated to result in the loss of any subpopulations or local populations of bull trout. A more detailed analysis of consulted-on effects to the bull trout is available in our files and is hereby incorporated by reference.

Ongoing Conservation Actions

Federal Conservation Actions

Federal conservation actions include: (1) The development of a draft *Bull Trout Recovery Plan*; (2) ongoing implementation of the *Interim Strategy for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California* (PACFISH; USDA and USDI 1995) and the *Interim Strategy for Managing Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana and Portions of Nevada* (INFISH; USDA 1995); (3) ongoing implementation of the Northwest Forest Plan; (4) ongoing implementation of the Northwest Power and Conservation Council Fish and Wildlife Program targeting subbasin planning; (5) ongoing implementation of the Federal Caucus Fish and Wildlife Plan; and (6) ongoing implementation of Department of Agriculture Conservation Reserve Programs.

State Conservation Actions

<u>Idaho</u>: Conservation actions by the State of Idaho include: (1) The development of a management plan for bull trout in 1993 (Conley 1993); (2) the approval of the *State of Idaho Bull Trout Conservation Plan* (Idaho Plan) in July 1996 (Batt 1996); (3) the development of 21 problem assessments involving 59 key watersheds; (4) the implementation of conservation actions identified in the problem assessments; and, (5) the implementation of more restrictive angling regulations.

<u>Montana</u>: Conservation actions by the State of Montana include: (1) Development of the *Montana Bull Trout Restoration Plan* issued in 2000 (MBTRT 2000), which defines strategies for ensuring the long-term persistence of bull trout in Montana; (2) formation of the Montana Bull Trout Restoration Team (MBTRT) and Montana Bull Trout Scientific Group (MBTSG) to produce a plan for maintaining, protecting, and increasing bull trout populations; (3) the development of watershed groups to initiate localized bull trout restoration efforts; (4) funding of

habitat restoration projects, recovery actions, and genetic studies throughout the state; (5) the abolition of brook trout stocking programs; and, (6) implementation of stricter angling regulations have also become more restrictive than in the past.

Nevada: Conservation actions by the State of Nevada include: (1) The preparation of a *Bull Trout Species Management Plan* that recommends management alternatives to ensure that Ahuman activities will not jeopardize the future of bull trout in Nevada" (Johnson 1990); (2) implementation of more restrictive State angling regulations in an attempt to protect bull trout in the Jarbidge River in Nevada; and, (3) the abolition of a rainbow trout stocking in the Jarbidge River.

Oregon: Since 1990, the State of Oregon has taken several actions to address the conservation of bull trout, including: (1) Establishing bull trout working groups in the Klamath, Deschutes, Hood, Willamette, Odell Lake, Umatilla and Walla Walla, John Day, Malheur, and Pine Creek river basins for the purpose of developing bull trout conservation strategies; (2) establishment of more restrictive harvest regulations in 1990; (3) reduced stocking of hatchery-reared rainbow trout and brook trout into areas where bull trout occur; (4) angler outreach and education efforts are also being implemented in river basins occupied by bull trout; (5) research to further examine life history, genetics, habitat needs, and limiting factors of bull trout in Oregon; (6) reintroduction of bull trout fry from the McKenzie River watershed to the adjacent Middle Fork of the Willamette River, which is historical unoccupied, isolated habitat; (7) the Oregon Department of Environmental Quality (DEQ) established a water temperature standard such that surface water temperatures may not exceed 10^{O} Celsius (50^{O} Fahrenheit) in waters that support or are necessary to maintain the viability of bull trout in the State (Oregon 1996); and, (8) expansion of the Oregon Plan for Salmon and Watersheds (Oregon 1997) to include all at-risk wild salmonids throughout the State.

Washington: Conservation actions by the State of Washington include: (1) Establishment of the Salmon Recovery Act (ESHB 2496) and Watershed Management Act (ESHB 2514) by the Washington State legislature to assist in funding and planning salmon recovery efforts; (2) abolition of a brook trout stocking in streams or lakes connected to bull trout-occupied waters; (3) changing angling regulations in Washington prohibit the harvest of bull trout, except for a few areas where stocks are considered "healthy"; (4) collecting and mapping updated information on bull trout distribution, spawning and rearing areas, and potential habitat; and, (5) adopting new emergency forest practice rules based on the "Forest and Fish Report" process. These rules address riparian areas, roads, steep slopes, and other elements of forest practices on non-federal lands.

Tribal Conservation Activities

Many Tribes throughout the range of the bull trout are participating on bull trout conservation working groups or recovery teams in their geographic areas of interest. Some tribes are also implementing projects which focus on bull trout or that address anadromous fish but benefit bull trout (*e.g.*, habitat surveys, passage at dams and diversions, habitat improvement, and movement studies).

Conservation Needs

Conservation needs reflect those biological and physical requirements of a species for its long-term survival and recovery. Based on the best available scientific information (Rieman and McIntyre 1993, MBTSG 1998, Hard 1995, Healey and Prince 1995, Rieman and Allendorf 2001), the conservation needs of the bull trout are to: (1) Maintain and restore multiple, interconnected populations in diverse habitats across the range of each DPS; (2) Preserve the diversity of life-history strategies (*e.g.*, resident and migratory forms, emigration age, spawning frequency, local habitat adaptations); (3) Maintain genetic and phenotypic diversity across the range of each DPS; and, (4) Protect populations from catastrophic fires across the range of each DPS. Each of these needs is described below in more detail.

Maintain and Restore Multiple, Interconnected Populations in Diverse Habitats Across the Range of Each DPS

Multiple local populations distributed and interconnected throughout a watershed provide a mechanism for spreading risk from stochastic events (Rieman and McIntyre 1993, Hard 1995, Healey and Prince 1995, Spruell *et al.* 1999, Rieman and Allendorf 2001). Current patterns in bull trout distribution and other empirical evidence, when interpreted in view of emerging conservation theory, indicate that further declines and local extinctions are likely (Rieman *et al.* 1997a, Dunham and Rieman 1999, Rieman and Allendorf 2001, Spruell *et al.* 2003). Based in part on guidance from Rieman and McIntyre (1993), bull trout core areas with fewer than five local populations are at increased risk of extirpation; core areas with between 5 to 10 local populations are at intermediate risk of extirpation; and core areas which have more than 10 interconnected local populations are at diminished risk of extirpation.

Maintaining and restoring connectivity between existing populations of bull trout is important for the persistence of the species (Rieman and McIntyre 1993). Migration and occasional spawning between populations increases genetic variability and strengthens population variability (Rieman and McIntyre 1993). Migratory corridors allow individuals access to unoccupied but suitable habitats, foraging areas, and refuges from disturbances (Saunders *et al.* 1991).

Because bull trout in the coterminous United States are distributed over a wide geographic area consisting of various environmental conditions, and because they exhibit considerable genetic differentiation among populations, the occurrence of local adaptation is expected to be extensive. Some readily observable examples of differentiation between populations include external morphology and behavior (*e.g.*, size and coloration of individuals; timing of spawning and migratory forays). Conserving many populations across the range of the species is crucial to adequately protect genetic and phenotypic diversity of bull trout (Leary *et al.* 1993, Rieman and McIntyre 1993, Hard 1995, Healey and Prince 1995, Spruell *et al.* 1999, Taylor *et al.*1999, Rieman and Allendorf 2001). Changes in habitats and prevailing environmental conditions are increasingly likely to result in extinction of bull trout if genetic and phenotypic diversity is lost.

Preserve the Diversity of Life-history Strategies

The bull trout has multiple life history strategies, including migratory forms, throughout its range (Rieman and McIntyre 1993). Migratory forms appear to develop when habitat conditions allow movement between spawning and rearing streams and larger rivers or lakes where foraging opportunities may be enhanced (Frissell 1997). For example, multiple life history forms (*e.g.*, resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem of the Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams and lakes, greater fecundity resulting in increased reproductive potential, and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Frissell 1997, Rieman and McIntyre 1993, MBTSG 1998).

Maintain the Genetic Diversity and Evolutionary Potential of Bull Trout Populations

When the long-term persistence of a species, taxon, or phylogenetic lineage is considered, it is necessary to consider the amount of genetic variation necessary to uphold evolutionary potential which is needed for that taxon to adapt to a changing environment. Effective population size provides a standardized measure of the amount of genetic variation that is likely to be transmitted between generations within a population. Effective population size is a theoretical concept that allows one to predict potential future losses of genetic variation within a population due to small population size and genetic drift. Individuals within populations with very small effective population sizes are also subject to inbreeding depression because most individuals within small populations share one or more immediate ancestors (parents, grandparents, *etc.*) after only a few generations and will be closely related.

The effective population size parameter (N_e) incorporates relevant demographic information that determines the evolutionary consequences of members in a population contributing to future generations (Wright 1931). When prioritizing populations for conservation, N_e is an important parameter because it is inversely related to the rate of loss of genetic diversity and the rate of increase in inbreeding in a population that is finite, but otherwise randomly mating (Waples 2002). Within a population, the census number of sexually mature adults per generation (N) and N_e are the same when the following conditions are met: constant and large population size, variance in reproductive success is binomial (number of progeny per parent follows a Poisson distribution), and sex ratio is equal. Because most populations do not conform to these conditions, the N_e to N ratio is usually below 1.0 (Frankham 1995), and the N_e to N ratio is thought to be between 0.15 and 0.27 in bull trout populations based on computer modeling (Rieman and Allendorf 2001).

A N_e of 50 or more is recommended to avoid the immediate effects of inbreeding and should be considered a minimum requirement for the short-term conservation of populations (Franklin 1980, Soulé 1987). Increased homozygosity of deleterious recessive alleles is thought to be the main mechanism by which inbreeding depression decreases the fitness of individuals within local populations (Allendorf and Ryman 2002). Deleterious recessive alleles are introduced into the genome via random mutations, and natural selection is slow to purge them because they are usually found in the heterozygous form where they are not detrimental. When populations become small, heterozygosity decreases at the rate of $1/(2\ N_e)$ per generation which in turn causes an increase in the frequency of homozygosity of the deleterious recessive alleles. Hedrick and Kalinowski (2000) provide a review of studies demonstrating inbreeding depression in wild populations.

Effective population sizes of 500 to 5000 have been recommended for the retention of evolutionary potential (Franklin and Frankham 1998, Lynch and Lande 1998). Populations of this size are able to retain additive genetic variation for fitness related traits gained via mutation (Franklin 1980).

Bull trout specific benchmarks have been developed concerning the minimum N_e necessary to maintain genetic variation important for short-term fitness and long-term evolutionary potential. These benchmarks are based on the results of a generalized, age-structured, simulation model, VORTEX (Miller and Lacy 1999), used to relate effective population size to the number of adult bull trout spawning annually under a range of life histories and environmental conditions (Rieman and Allendorf 2001). In this study, the authors estimated N_e for bull trout to be between 0.5 and 1.0 times the mean number of adults spawning annually. Rieman and Allendorf (2001) concluded that an average of 100 (*i.e.*, 100 x 0.5 = 50) adults spawning each year would be required to minimize risks of inbreeding in a population and 1000 adults (*i.e.*, 1000 x 0.5 = 500) is necessary to maintain genetic variation important for long-term evolutionary potential. This latter value of 1000 spawners may also be reached with a collection of local populations among which gene flow occurs.

The combination of resident forms completing their entire life cycle within a stream and the homing behavior of the migratory forms returning to the streams where they hatched to spawn promotes reproductive isolation among local bull trout populations. This reproductive isolation creates the opportunity for genetic differentiation and local adaptations to occur. Nevertheless, within a core area local populations are usually connected through low rates of migration. This connection of local populations, linked by migration, is termed a metapopulation (Hanski and Gilpin 1997). Within a metapopulation, evolution primarily occurs at the local population level (*i.e.*, it is the main demographic and genetic unit of concern). However, when longer time frames are considered (*e.g.*, 10 plus generations), metapopulations become important. For example, metapopulations allow for the reintroduction of lost alleles and recolonization of extinct local breeding populations. Migration and gene flow among local populations ensures that the alleles within a metapopulation will be present in most local breeding populations and can be acted on by natural selection (Allendorf 1983).

Maintain Phenotypic Diversity

Healy and Prince (1995) reported that, because phenotypic diversity is a consequence of the genotype interacting with the habitat, the conservation of phenotypic diversity is achieved through conservation of the sub-population within its habitat. They further note that adaptive variation among salmonids has been observed to occur under relatively short time frames (*e.g.*, changes in genetic composition of salmonids raised in hatcheries; rapid emergence of divergent phenotypes for salmonids introduced to new environments). Healy and Prince (1995) conclude that while the loss of a few sub-populations within an ecosystem might have only a small effect on overall genetic diversity, the effect on phenotypic diversity and, potentially, overall population viability could be substantial. This concept of preserving variation in phenotypic traits that is determined by both genetic and environmental (*i.e.*, local habitat) factors has also been identified by Hard (1995) as an important component in maintaining intraspecific adaptability (*i.e.*, phenotypic plasticity) and ecological diversity within a genotype. He argues that adaptive processes are not entirely encompassed by the interpretation of molecular genetic data; in other words, phenotypic and genetic variation in adaptive traits may exist without detectable variation at the molecular genetic level, particularly for neutral genetic markers. Therefore, the effective conservation of genetic diversity necessarily involves consideration of the conservation of biological units smaller than taxonomic species (or DPSs). Reflecting this theme, the maintenance of local sub-populations has been specifically emphasized as a mechanism for the conservation of bull trout (Rieman and McIntyre 1993, Taylor *et al* 1999).

Protect Bull Trout from Catastrophic Fires

The bull trout evolved under historic fire regimes in which disturbance to streams from forest fires resulted in a mosaic of diverse habitats. However, forest management and fire suppression over the past century have increased homogeneity of terrestrial and aquatic habitats, increasing the likelihood of large, intense forest fires in some areas. Because the most severe effects of fire on native fish populations can be expected where populations have become fragmented by human activities or natural events, an effective strategy to ensure persistence of native fishes against the effects of large fires may be to restore aquatic habitat structure and life history complexity of populations in areas susceptible to large fires (Gresswell 1999).

Rieman and Clayton (1997) discussed relations among the effects of fire and timber harvest, aquatic habitats, and sensitive species. They noted that spatial diversity and complexity of aquatic habitats strongly influence the effects of large disturbances on salmonids. For example, Rieman *et al.* (1997b) studied bull trout and redband trout responses to large, intense fires that burned three watersheds in the Boise National Forest in Idaho. Although the fires were the most intense on record, there was a mix of severely burned to unburned areas left after the fires. Fish were apparently eliminated in some stream reaches, whereas others contained relatively high densities of fish. Within a few years after the fires and after areas within the watersheds experienced debris flows, fish had become reestablished in many reaches, and densities increased. In some instances, fish densities were higher than those present before the fires or in streams that were not burned (Rieman *et al.* 1997b). These responses were attributed to spatial habitat diversity that supplied refuge areas for fish during the fires, and the ability of bull trout and the redband trout to move among stream reaches. For bull trout, the presence of migratory fish within the system was also important (Rieman and Clayton 1997, Rieman *et al.*1997b).

In terms of conserving bull trout, the appropriate strategy to reduce the risk of fires on bull trout habitat is to emphasize the restoration of watershed processes that create and maintain habitat diversity, provide bull trout access to habitats, and protect or restore migratory life-history forms of bull trout. Both passive (*e.g.*, encouraging natural riparian vegetation and floodplain processes to function appropriately) and active (*e.g.*, reducing road density, removing barriers to fish movement, and improving habitat complexity) actions offer the best approaches to protect bull trout from the effects of large fires.

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